



# NOT TO BE IGNORED

Global warming is not a myth, there is solid scientific evidence for it. If humanity opts to ignore it, it will come to a catastrophic end.



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**G**lobal and local temperatures are breaking record after record. Extreme weather is wreaking havoc, leaving behind trails of devastation. Ice is disappearing in the Arctic, the snow cover continues to decline, and groundwater levels are decreasing. Intense heat waves and droughts are causing lower crop yields, forcing people to migrate. In Poland, limited rainfall and the

continuous drop in groundwater levels are affecting crops and forests. Increasingly more violent storms are destroying property, sometimes even causing death. These are facts.

## The forecast

The scientific world knows and understands the reasons for this state of affairs. Nearly 200 years ago, based on observational data and his understanding of the planet's energy balance, the French mathematician and physicist Joseph Fourier proposed the existence of a phenomenon known to us today as the greenhouse effect. Over 150 years ago, the pioneer Irish physicist and naturalist John Tyndall discov-

ered that the key greenhouse gases are carbon dioxide, methane and water vapor. He hypothesized that changes in the concentration of these gases in the atmosphere were responsible for the occurrence of ice ages. In the late nineteenth century, the Swedish chemist and physicist Svante Arrhenius, realizing that the amount of carbon dioxide in the atmosphere was increasing due to the combustion of fossil fuels, estimated changes in the surface temperature of the planet when the concentration of CO<sub>2</sub> increased and decreased by a factor of two. Using measurements provided by American physicist and engineer Samuel Langley on the transfer of solar and infrared radiation through the atmosphere, Arrhenius showed that the biggest changes would occur at high latitudes, a phenomenon that today we refer to as polar or arctic amplification. In the 1930s, the English engineer and inventor Guy Stewart Callendar showed that the temperature rise already observed was most likely due to the increased concentration of carbon dioxide in the air. These were pioneering works in the field of climate physics.

In Poland there is insufficient understanding of the problem, its scale and likely dramatic consequences, which, in the event of further neglect, will affect all people and the natural world as a whole.

During the Cold War, numerous research projects sponsored by the military, especially by the US Naval Research Office, made it possible to better understand how we are heating up the planet by increasing the greenhouse effect. Scientists then began to measure and calculate the radiative transfer of energy through the atmosphere. Observing the spread of radioactive isotopes after nuclear explosions, scientists studied ocean circulation and heat transport by sea currents. Studying the isotopic composition of carbon in CO<sub>2</sub> present the air and in ocean waters helped prove beyond any doubt that the burning of fossil fuels is responsible for its increased concentration in the atmosphere and hydrosphere. Studying the isotope composition of oxygen in marine sediments and ice cores confirmed the sensitivity of our planet's climate

to even the slightest forcing. All these studies led to the conclusion that mankind is conducting a unique geophysical experiment, something that is beyond the capabilities of nature itself. By emitting carbon dioxide into the atmosphere at a huge rate, rapidly releasing carbon that had been accumulated in sedimentary rocks over millions of years, humans are disturbing the natural carbon cycle in the atmosphere, ocean and biosphere on a vast, planetary scale, causing changes to the climate unprecedented in the natural history of our planet.

## The alarm

Concerned about possible consequences, researchers began to warn politicians and the public against this threat. This began with a report submitted to US President Johnson in 1965, which stated that a further increase in emissions over several decades could lead to enormous and rapid changes in air temperatures at the surface and sea level.

The report dealt with the state of the environment in general, the chapter on the climate change being just one of many, but it initiated many positive responses. It made us aware of our impact on the environment and inspired us to attempt to control it in order to minimize the negative effects. Today, emitting sulfur oxides, nitrogen oxides and many other substances to the atmosphere does not go unpunished in developed countries. We are no longer draining toxic waste into rivers, lakes and seas. One thing remains unchanged, however: the fact that we continue to treat the atmosphere as a free dump for carbon dioxide.

Despite the overwhelming evidence that by strengthening the greenhouse effect we are destabilizing the climate on which we depend 100%, we are not stopping these emissions, or even slowing them down. Reports by the specially-established Intergovernmental Panel on Climate Change (IPCC) show that we are quickly approaching a climatic catastrophe. Recent publications, including the IPCC Special Report on the global warming of 1.5°C, show that we have no time to lose and need to rapidly reduce our CO<sub>2</sub> emissions to zero.

## The price of ignorance

In Poland, meanwhile, there is unfortunately insufficient understanding of the problem, its scale and likely dramatic consequences, which, in the event of further neglect, will affect all people and the natural world as a whole. In the media, politicians and publicists either avoid mentioning this issue or sweep it under the carpet. They often hold views completely contrary to the well documented evidence. The scien-





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is the Director of the Institute of Geophysics at the Faculty of Physics, University of Warsaw. He specializes in physics of clouds and precipitation, atmospheric turbulence, numerical modeling of atmospheric processes, and non-linear processes in the atmosphere. An active promoter of science, author of the climate-science blog "*Nauka o klimacie*" and co-author of a book of the same title. Winner of the 2017 Science Popularization contest in the "team" category.

tific community also has its share of global warming deniers, widely propagating their views, contradicting the knowledge about how the climate system works. No "cycles" or "galactic cosmic ray interactions" can explain the phenomena we are observing at the moment. Measurements of the planet's energy balance, radiation spectra, and ocean temperatures provide an unambiguous explanation, confirmed by many independent studies, of current global warming, while calculations based on the laws of physics and collected data provide information on the potential future.

However, in Poland the threat of a climate disaster is not seen as an important argument in favor of striving for a zero-emissions society. The priority is, instead, to preserve the current state of the economy, and emissions. What is the background of this absurdity? One of the most serious problems is the lack of scientific consultation in the field of modern physical climatology.

Many descriptive climatology specialists in the country are working independently or in small groups at numerous universities and institutes providing information on the changing climate. What we lack are strong, well-organized and properly equipped research groups in the field of physical climatology, numerical modeling of atmospheric processes, and basic research in the field of atmosphere physics. They should provide an understanding of the cause-and-effect relationships based on the basic laws of physics, propagate this knowledge to the public, and provide sensible advice to politicians, public administration, and businesses.

We have no research institutions able to provide specialized modern climate services to decision-makers. Various types of reports are published, but this usually happens through individual grants or projects financed from foreign research funding, and so it fails to ensure continuity or to build up scientific or consultative potential in this respect. The underfunded Polish Institute of Meteorology and Water Management is barely coping with the country's weather services and basic weather forecasts, and the Institute of Environmental Protection is desperately looking for

specialists. Meanwhile Polish universities lack the staff to train new meteorological and climate professionals in compliance with the international standards described in the guidelines of the World Meteorological Organization (WMO).

Poland does not have enough human resources and funding for research, development and responsible consultancy in the field of climate policy. It lacks the appropriate organizational structures, and there is also a lack of awareness of what modern science can offer in this area. As one of the consequences, public and private debate on the topic is quite limited, barring occasional mentions in news stories about natural disasters, or during political events like COP 24 in Katowice. Meanwhile, climate change is increasingly affecting us, and it will soon have a dire impact on Poland, as shown by the abovementioned reports.

## It depends on us

Global warming is progressing. Poland, Europe, and the world must adapt to the accelerating climate change, while simultaneously doing everything to slow its pace and keep global warming from going beyond 1.5°C above pre-industrial levels. Recent studies from many research centers around the world show that this number is just below the "limit of climate safety," which is estimated to be warming above 2°C. Passing this threshold will unleash powerful natural forces that will further increase warming, due to uncontrolled and unstoppable emissions of greenhouse gases from the frozen organic matter in the Arctic. The margin of error is small. If we go beyond this margin, we are heading for a climate and biosphere disaster on a planetary scale, one which neither man nor nature known to man might survive.

In short: the climate will not be ignored. We can still stop this disaster from happening, albeit on one condition – we have to really want to do so.

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